940,405

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DRAWINGS ATTACHED.

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COMPLETE SPECIFICATION.

Change Speed Transmission.

We, BORG-WARNER CORPORATION, a Corporation organised and existing under the laws of the State of Illinois, United States of America, of 200 South Michigan Avenue, Chicago 4, Cook County, Illinois, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to change speed transmission and more particularly to an improved hydraulically actuated clutch assembly for such transmission.

It is the general objective of this invention to provide an improved clutch assembly for use in such applications, for example, as power shifted transmissions for automotive vehicles wherein a quick drag-free clutch release is required for efficient operation.

An example of a possible application of the present invention is in a truck transmission having a hydro-kinetic torque transmitting device such as a torque converter coupled with a multi-ratio counter shaft gear box. Clutches of the general type to which this improvement is directed are used between the converter and the gear box for providing a quick disconnect between the converter and the gear box so that the operator may change speed ratios.

Many of the clutches of this type now in existence consist of a driving and driven member having a plurality of intermeshed clutched discs and a hydraulically actuated piston to force the plates into engagement. When such a clutch is disconnected it has been found that there is a distinct time lag in completing the disengagement of the clutch due to the frictional drag between the numerous plates and the time required for the plates to separate, which necessarily causes a certain amount of torque to be transmitted during the time the operator is attempting to shift. When the operator is attempting an unsynchronized shift into first or reverse, for instance, he experiences considerable difficulty due to the clutch drag which causes the input shaft to rotate thereby impeding gear mesh. In addition, considerable wear on clutch parts is experienced which increases maintenance expense. If the operation is attempting to shift between intermediate synchronized gear ratios, the synchronizer is subjected to undue loads due to the drag characteristic of the conventional clutch mechanisms.

Various attempts to overcome this pressing disadvantage have included attempts to brake the input shaft of the gear box to help overcome the drag, but such attempts have proven inefficient and often expensive.

According to this invention, we provide a compact quick disconnet clutch assembly mounted in a casing and including first and second co-axial rotatable members; a pressure plate and a backing plate mounted on said first member for rotation therewith, a friction clutch disc mounted on said second member for rotation therewith and positioned between said pressure plate and said backing plate; a fluid servo mounted in said casing and including a piston member actuatable between first and second positions, a first belleville spring disposed between said piston and said pressure plate, and having a radially outward portion thereof anchored to said first member to act as a fulcrum, a radially inward portion in contact with said piston, and an intermediate portion in contact with said pressure plate on an opposite side thereof from said piston

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and effective to act as a flexible lever to transmit force from said piston in said first position to said pressure plate for frictionally interengaging said clutch disc between said pressure plate and said backing plate whereby a torque transmitting connection is provided between said first member and said second member when fluid pressure is supplied to said servo, and said belleville spring being effective to return said piston to said second position when fluid pressure is released from said servo, and a second belleville spring means positioned in said casing and having a radially outward portion engaging said pressure plate and a radially inward portion engaging said first rotatable member and effective to bias said pressure plate towards the piston second position for providing a drag free disengagement of said clutch when the piston is moved to the second position.

In order that this invention may more readily be understood, reference will now be made by way of example to the accompanying drawings, in which:—

Figure 1 is a sectional view of a transmission including a torque converter and a multi-ratio gear box interconnected by a clutch assembly according to this invention;

Figure 2 is an enlarged sectional view of the clutch assembly of Figure 1; and

Figure 3 is a schematic diagram of the torque converter and clutch actuating circuit.

A power shifted transmission for an automotive vehicle is shown generally at 10, and comprises a hydro-kinetic torque transmitting device such as a torque converter 11, a mechanical counter shaft gear box 12 and a power shifted clutch 13 interconnecting the converter at the command of the operator.

The torque converter 11 comprises an impeller I connected to a source of power, a turbine or output member T and a stator or reaction member S. The converter is conventional in design and operation and no further description is deemed necessary.

The turbine T is connected to the clutch 13 by means of shaft 14. The clutch comprises, generally, a casing 15, an input member 16, to which shaft 14 is connected for transmitting the output from the converter to the clutch, and an output member 17 in telescoping relation to the input member, both members being rotatable about the same axis, and fluid pressure responsive servo means including piston 18 for selectively engaging and disengaging the input and output members for transmitting torque through the clutch.

More particularly clutch engaging means is provided including, a single annular clutch plate or disc 19 which is rotatable secured such as splined to the output member 17 and is rotatable therewith while being axially movable thereon. The clutch plate has a pair of mutually opposed friction surfaces 20, and is immediately adjacent to, and sandwiched between, an annular backing plate 21 and an annular pressure plate 22, both of which are splined to the input member 16 and rotatable therewith.

The servo piston 18 is disposed in the chamber 25 within the casing 15 of the clutch and is axially movable therein in response to fluid pressure on a dished surface 26 thereof. A second chamber 27 is formed between the piston-surface 26 and the wall of the casing, and the fluid inlet port 28 opens into the chamber. A centrifugal pressure relief check valve 30 is also provided at the radially outward wall of the casing and functions to assure the complete exhausting of fluid from the servo cavity 27 when the clutch apply pressure is released.

The radially extending "belleville" type spring 31 has two important functions, the first being to act as a return spring for the piston when the pressure is relieved from the servo cavity and the second, to function as a lever between the piston 18 and the pressure plate 22.

A second, radially extending "belleville" type spring 40 is also provided radially inwardly of the pressure plate, a radially inward terminal 41 thereof being secured to the input member by some appropriate means such as clip ring 42, another terminal 43 being in contact with a flanged portion 44 of the pressure plate. The springs 31 and 40 are located immediately adjacent one another so as to provide as compact a structure as possible.

The output member of the quick disconnect clutch is connected to the input shaft 46 of the gear box 12 and is effective to receive torque transmitted through the clutch. The gear box consists of a casing 45, the input shaft 46, an output shaft 47 and a plurality of gears mounted on the shafts. The gears are so arranged on the shafts so that a number of speed ratios may be obtained by selectively intermeshing pairs of gears. A manual shifting lever 50 is at the disposal of the operator of the vehicle for selectively moving the gears into various combinations, and an electric circuit actuating button 51 is provided, for operating a solenoid 52, the function of which will be made clear soon hereafter.

A hydraulic control system is provided as indicated in Figure 3 and consists generally of a source of fluid pressure, a generally well-known means for regulating the pressure in the torque converter, and means selectively operable by the driver for energizing and de-energizing the clutch 13.

More particularly, a pump P provides a fluid pressure in conduit 55 which is divided into conduits 56 and 57. Conduit

57 directs fluid to the primary pressure regulator valve V1 where the line pressure from the pump is modulated and passed from port 58 through conduit 59 to the secondary pressure regulating valve V2. The pressure in conduit 59 is further modulated to an acceptable converter pressure valve V2 and supplied to the converter through conduit 60.

Fliud then leaves the converter through conduit 61 which divides into conduits 62 and 63.

Conduit 62 provides lubrication for the gear box 12 and there the fluid is accumulated in the transmission sump St. Conduit 63 directs the remainder of the converter discharge fluid into the clutch sump Sc. A transfer pipe 64 interconnects the transmission sump and the clutch sump so as to maintain a constant fluid level.

A portion of the fluid entering the valve V2 is removed from the line 59 as means of effectively modulating to converter pressure. The portion subtracted passes by means of conduit 66 through a heat exchange C to cool the fluid, and thence to the clutch sump Sc by conduit 67. The remainder of the subtracted fluid is directed to the intake side 68 of the pump P by means of conduit 69. A second conduit 70 interconnects the pump inlet 68 and the clutch sump.

Fluid under modulated pump pressure also passes through conduit 56, and through a check valve 71 where a portion thereof fills an accumulator valve A and the excess passes to a solenoid valve 75 through conduit 72.

The clutch energizing circuit comprises the solenoid valve 75 connected to an electrically actuated solenoid 52 which is energized at the option of the operator by switch 51. In the solenoid de-energized position fluid from conduit 72 passes into the valve 75 through port 76 and out through port 77, through conduit 78 to the clutch 13 and the clutch is engaged. In the energized position of the solenoid conduit 72 is blocked by the valve 75 and conduit 78 is opened to exhaust through port 79, and the clutch is drained and accordingly disengaged.

Having provided a detailed description of the transmission mechanism, the operation of the preferred embodiment of the present invention will now be described.

Assuming the transmission to be in neutral with the clutch released, torque from the engine is transmitted to the torque converter where it is multiplied and transmitted by means of shaft 13 to the clutch input member. Since the clutch is in the disengaged position, there is relative rotation between the input and output members, there is no torque transmitted to the clutch output member 17 and the vehicle is stationary.

The operator depresses the button 51 then moves the manual shift lever 50 to a position engaging a set of gears in the gear box 12 to provide a desired speed ratio and then releases the clutch button 51 on the gear shift lever to engage the clutch.

The solenoid is immediately de-energized and the solenoid valve 75 is moved to the right from the position shown in Figure 3 into the clutch engaged position. A direct fluid passage is thus provided from the accumulator valve A through valve conduits 72 and 78, to the clutch. Fluid stored in the accumulator valve functions to immediately fill the clutch chamber 27, fluid pressure in the chamber being at modulated pump pressure as determined by the primary valve V1.

Fluid forced into chamber 27 from the accumulator acts against the face 26 of the piston 18 in the clutch tending to move the piston to the right as viewed in Figures 1 and 2 against the combined resistive forces of the belleville spring 31, engagement pressure of the clutch disc and the second belleville spring 40. The mechanical advantage provided by the belleville spring 31 acting as a lever, multiplies the fluid pressure force acting against the piston for moving the pressure plate against the clutch plate whereby the clutch plate friction surfaces 20 are moved into friction engagement with the backing plate 21 and the pressure plate 22. As long as sufficient fluid pressure remains acting against the piston 18, the pressure plate 22 will be held in engagement with the clutch plate 19 and backing plate 21 for providing a torque transmitting connection between the input and output members of the clutch. It should be noted that the belleville spring 31 is advantageously employed to provide a mechnical advantage in order that a relatively small fluid pressure may effectively hold a single clutch plate having a relatively small friction surface in engagement for transmitting high torques to the gear box, and to the driving wheels of the vehicle.

The second belleville spring 40 is so positioned as to resist the movement of the pressure plate to the right as seen in Figure 1, and is effective to provide a continuous bias to urge the pressure plate towards the clutch disengaged position. As the pressure plate is moved to the engaged position in response to the force exerted by the piston the second belleville spring 40 is "flexed" by such movement whereby a reaction force is created which provides the before mentioned bias on the pressure plate. The clutch is so constructed that the force exerted by the piston on the first belleville spring is sufficient to hold the pressure plate against

the bias of the second belleville washer so as to hold the clutch in torque transmitting relation while the piston is in the actuated position.

When the operator of the vehicle desires to shift gear ratios, he does so by depressing the button 51 on the gear shift lever 50 which energizes the solenoid 52 and moves the solenoid valve 75 to the de-energized position. In this position the valve conduit 78, leading to the clutch chamber 27, is opened directly to the sump through port 79. Fluid in the clutch, which is under considerable pressure is immediately drained from the chamber thereby relieving fluid pressure on the face 26 of the piston to a value insufficient to maintain clutch engagement.

The belleville spring 31 which was previously "flexed" by the engagement of the clutch now acts with a reaction force determined by the design of the spring and the amount of deflection, to return the piston 18 to the left. Accordingly, the second spring 40, which has also been "flexed" by the movement of the pressure plate 22, acts on the pressure plate with a predetermined force to quickly urge the pressure plate to the clutch disengage position. Due to this added mechanical force on the pressure plate, the usual lag encountered in the normal disengagement of the conventional multi-plate clutches is eliminated, and the single plate herein provided is immediately disengaged from backing plate and the pressure plate providing a drag-free disengagement of the clutch.

Since the torque on the input shaft of the gear box is immediately relieved, the operator may shift gears rapidly without fear of gear or synchronizer damage, and thereafter release the clutch button for again actuating the clutch in the manner before described.

WHAT WE CLAIM IS:—

1. A compact quick disconnect clutch assembly mounted in a casing and including first and second co-axial rotatable members; a pressure plate and a backing plate mounted on said first member for rotation therewith, a friction clutch disc mounted on said second member for rotation therewith and positioned between said pressure plate and said backing plate; a fluid servo mounted in said casing and including a piston member actuatable between first and second positions, a first belleville spring disposed between said piston and said pressure plate, and having a radially outward portion thereof anchored to said first member to act as a fulcrum, a radially inward portion in contact with said piston, and an intermediate portion in contact with said pressure plate on an opposite side thereof from said piston and effective to act as a flexible lever to transmit force from said piston in said first position to said pressure plate for frictionally interengaging said clutch disc between said pressure plate and said backing plate whereby a torque transmitting connection is provided between said first member and said second member when fluid pressure is supplied to said servo, and said belleville spring being effective to return said piston to said second position when fluid pressure is released from said servo: and a second belleville spring means positioned in said casing and having a radially outward portion engaging said pressure plate and a radially inward portion engaging said first rotatable member and effective to bias said pressure plate towards the piston second position for providing a drag-free disengagement of said clutch when the piston is moved to the second position.

2. A compact quick disconnect clutch assembly mounted in a casing and including first and second co-axial rotatable members; a pressure plate and a backing plate mounted on said first member for rotation therewith, a single friction clutch disc mounted on said second member for rotation therewith and positioned between said pressure plate and said backing plate; a fluid servo mounted in said casing and including a piston member actuatable between first and second positions, a first belleville type spring disposed between said piston and said pressure plate, and having a radially outwardly peripheral portion anchored within said first rotatable member to act as a fulcrum, a radially inward portion in contact with said piston, and an intermediate portion in contact with said pressure plate on an opposite side thereof from said piston, said first belleville spring means being effective as a resilient lever for transmitting and multiplying the force of said piston in said first position when fluid pressure is supplied to said servo for providing an increased force on said pressure plate for interengaging said clutch disc with said pressure plate and said backing plate whereby a high torque transmitting connection is provided between said first member and said second member and said spring being effectve to return said piston to its second position when fluid pressure is released from said servo; and a second belleville type spring means also positioned on said first member and having a radially outward portion engaging said pressure plate and a radially inward portion engaging said first rotatable member and effective to bias said pressure plate towards the piston second position for providing a drag-free disengagement of said clutch when said piston is moved to said second position.

3. A clutch assembly as claimed in

Claim 2 wherein said first belleville spring has a larger diameter than said second belleville spring.

4. In a drive unit for an automotive vehicle, the combination of a hydro-kinetic torque transmitting device, a countershaft transmission for selectively providing a plurality of speed ratios and a compact quick disconnect clutch assembly interconnecting said torque transmitting device and said transmission; said clutch assembly being mounted in a casing and including first and second co-axial rotatable members; a pressure plate and a backing plate mounted on said first member for rotation therewith, a single friction clutch disc mounted on said second member for rotation therewith and positioned between said pressure plate and said backing plate; a fluid servo mounted in said casing and including a piston member actuatable between first and second positions, a first relatively large belleville spring disposed between said piston and said pressure plate, and having a radially outward portion thereof anchored to said first rotatable member to act as a fulcrum, a radially inward portion in contact with said piston, and an intermediate portion in contact with said pressure plate on an opposite side thereof from said piston, said first belleville spring being effective to act as a flexible lever to transmit force from said piston in said first position to said pressure plate for effecting the interengagement of said clutch disc between said pressure plate and said backing plate whereby a torque transmitting connection is provided between said first member and said second member when fluid pressure is supplied to said servo, and to return said piston when fluid pressure is released from said servo; and a second relatively small belleville spring as compared to said first spring positioned on said first rotatable member immediately axially adjacent said first belleville spring, and having a radially outward portion engaging said pressure plate and a radially inward portion engaging said first rotatable member, said second belleville spring being effective to bias said pressure plate towards the piston second position for providing a drag-free disengagement of said clutch when said piston is moved to said second position.

5. A clutch assembly substantially as hereinbefore described with reference to and as shown by the accompanying drawings.

6. A drive unit for an automotive vehicle substantially as hereinbefore described with reference to and as shown by the accompanying drawings.

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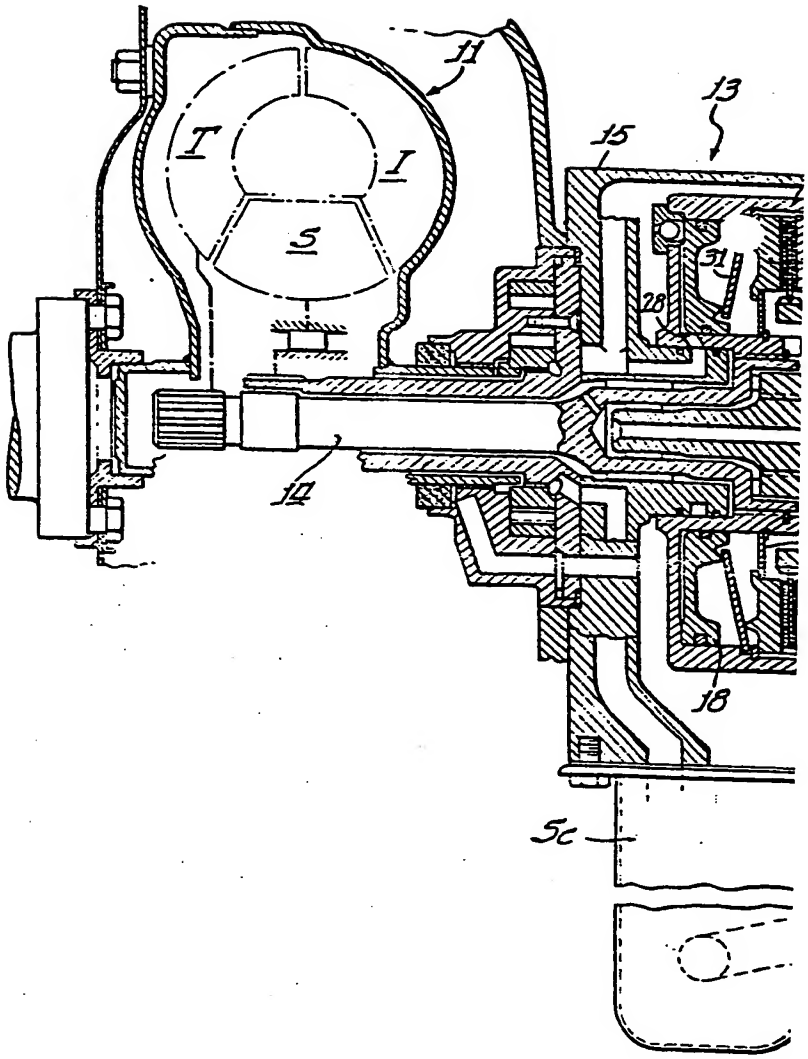
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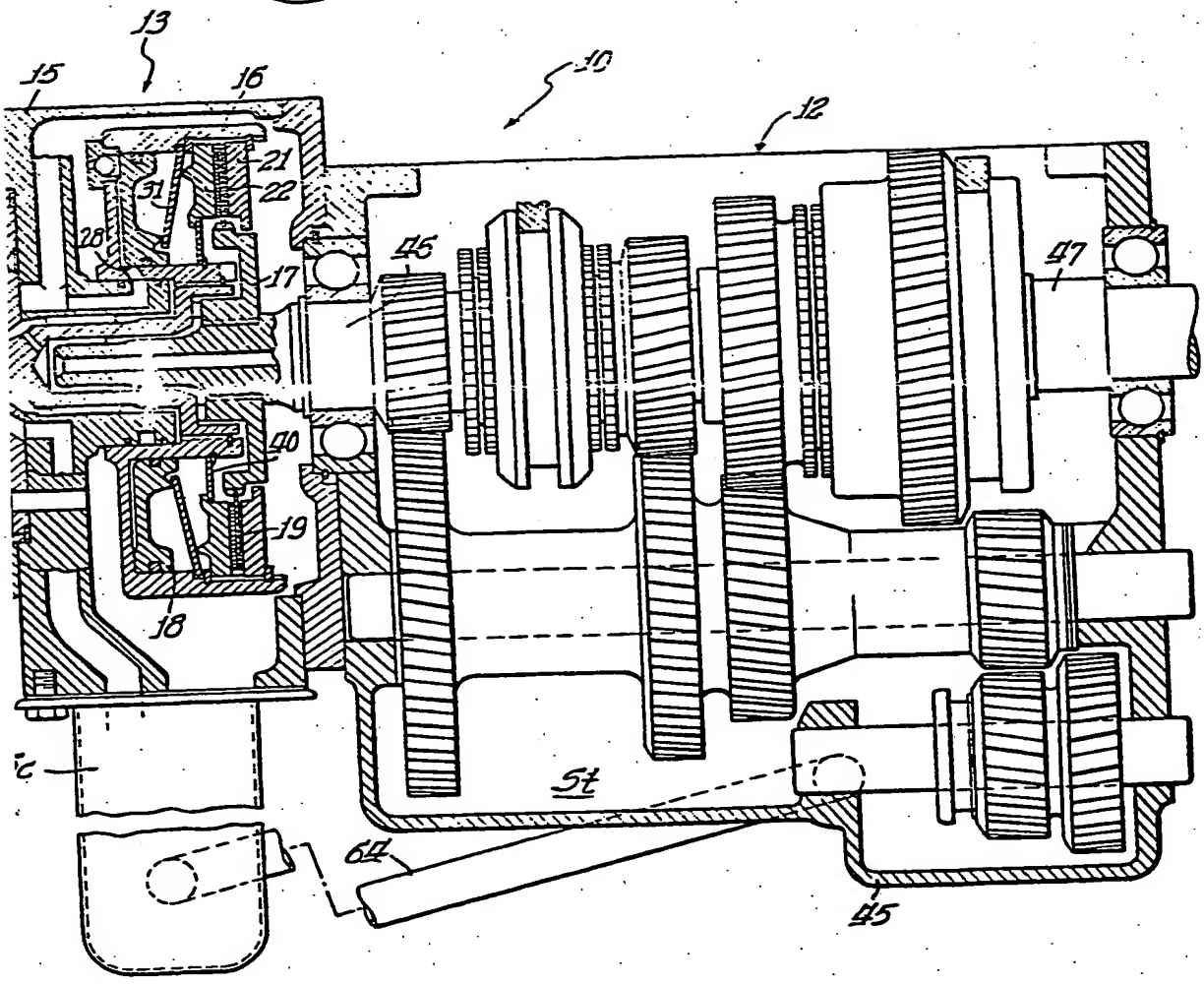
Fig. 1



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Sheet 1

Fig. 1

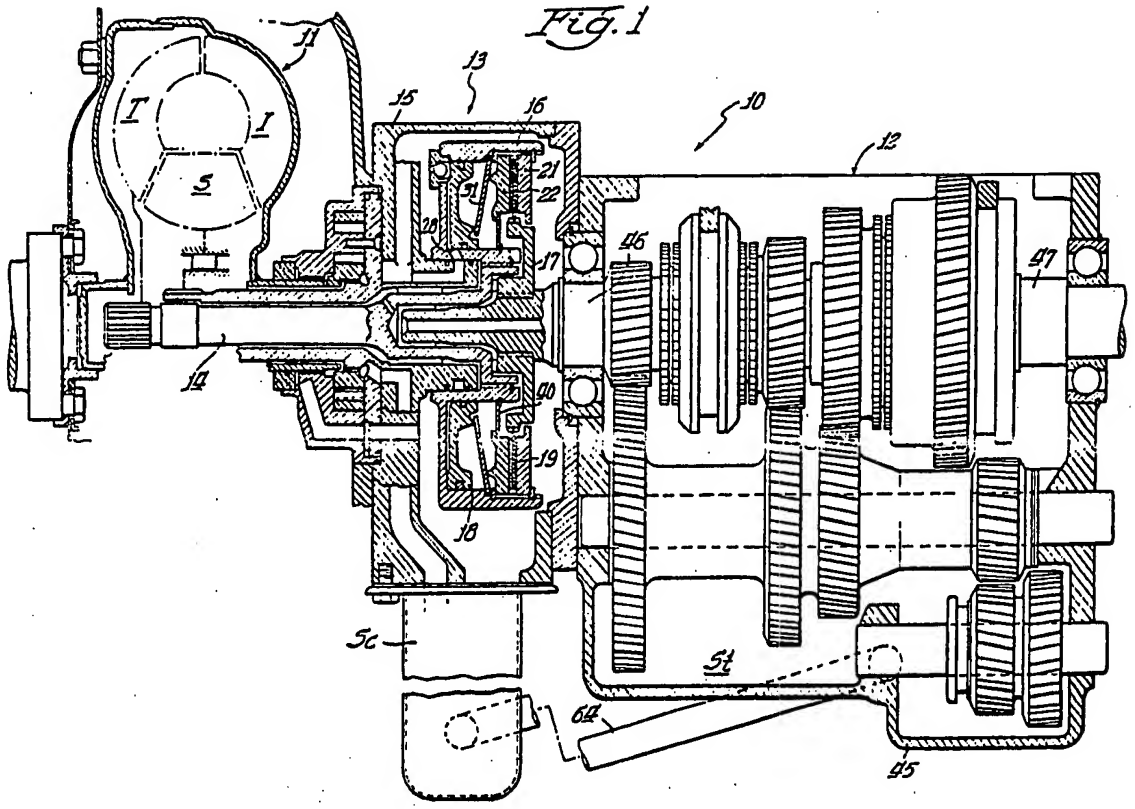
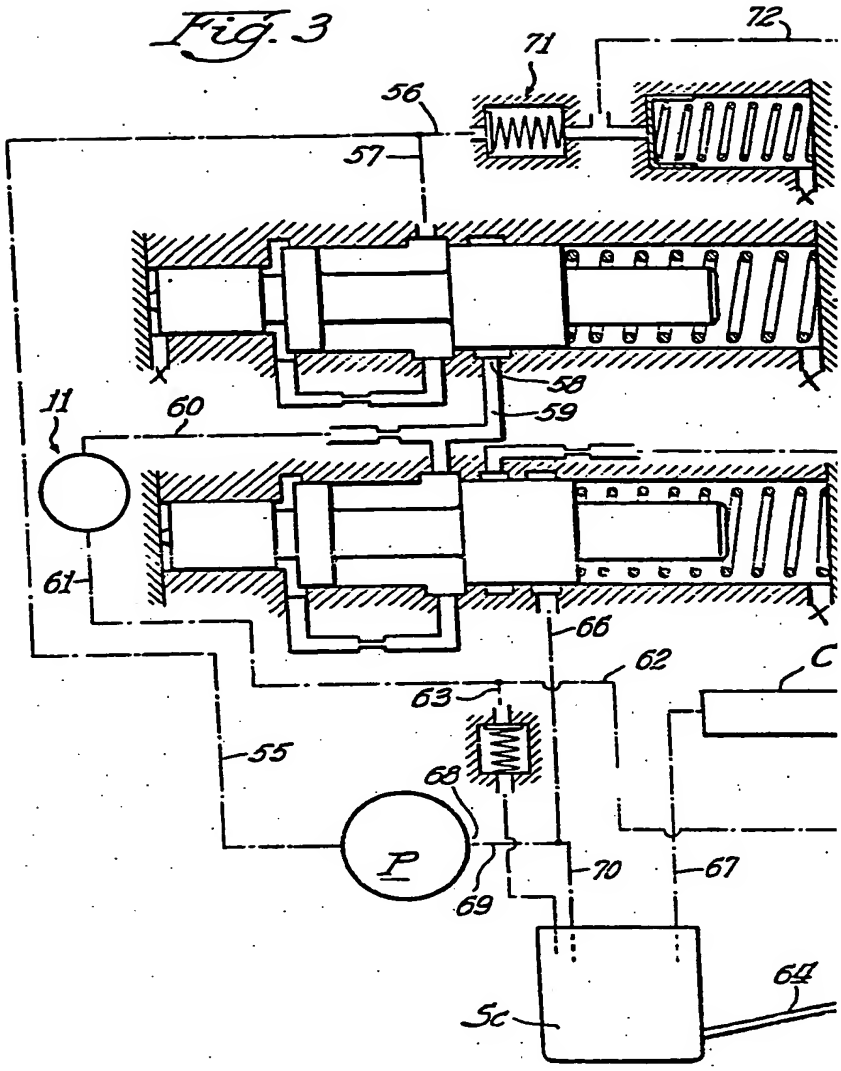


Fig. 3



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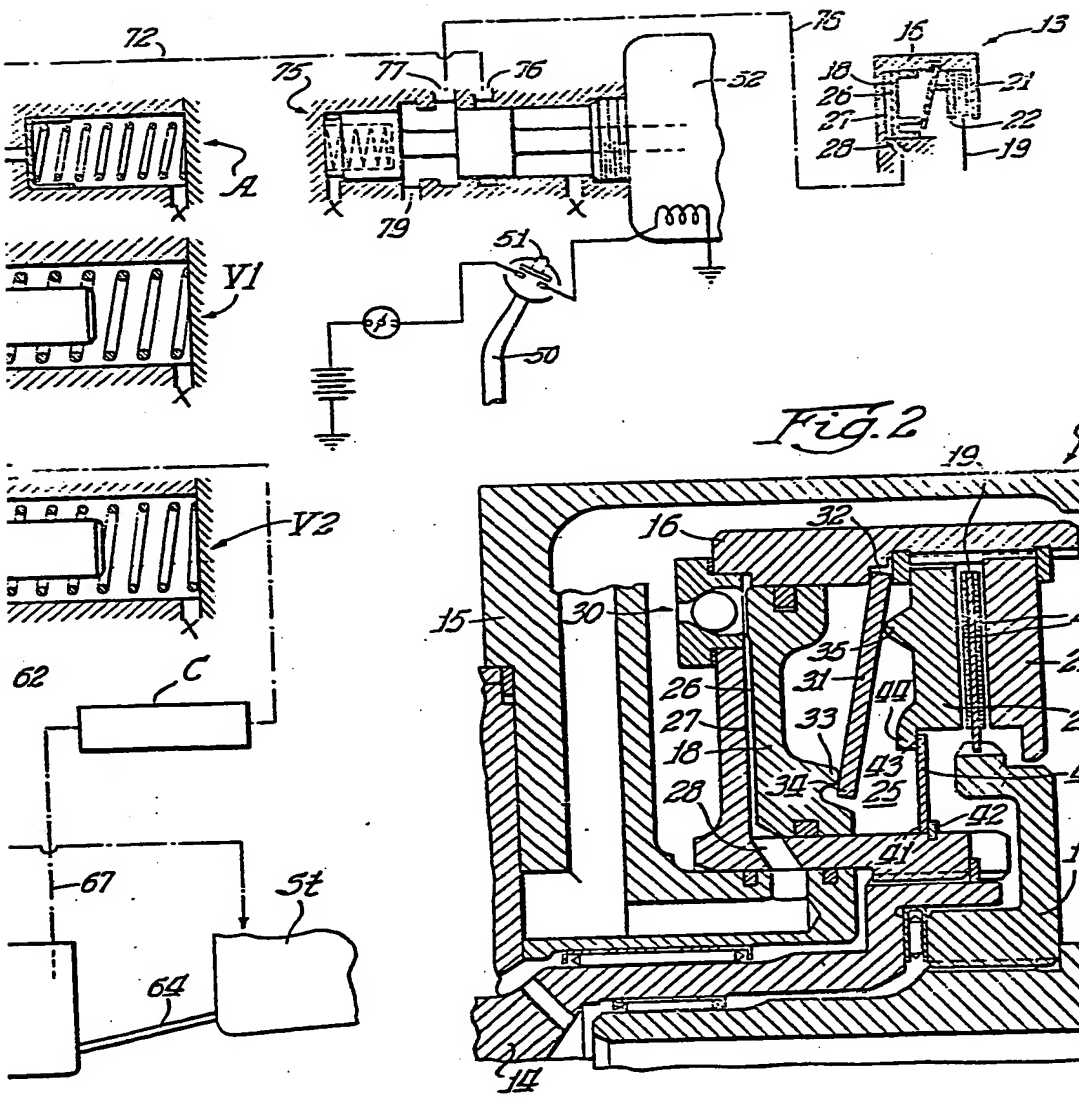
Sheet 2



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Sheet 2

Fig. 3

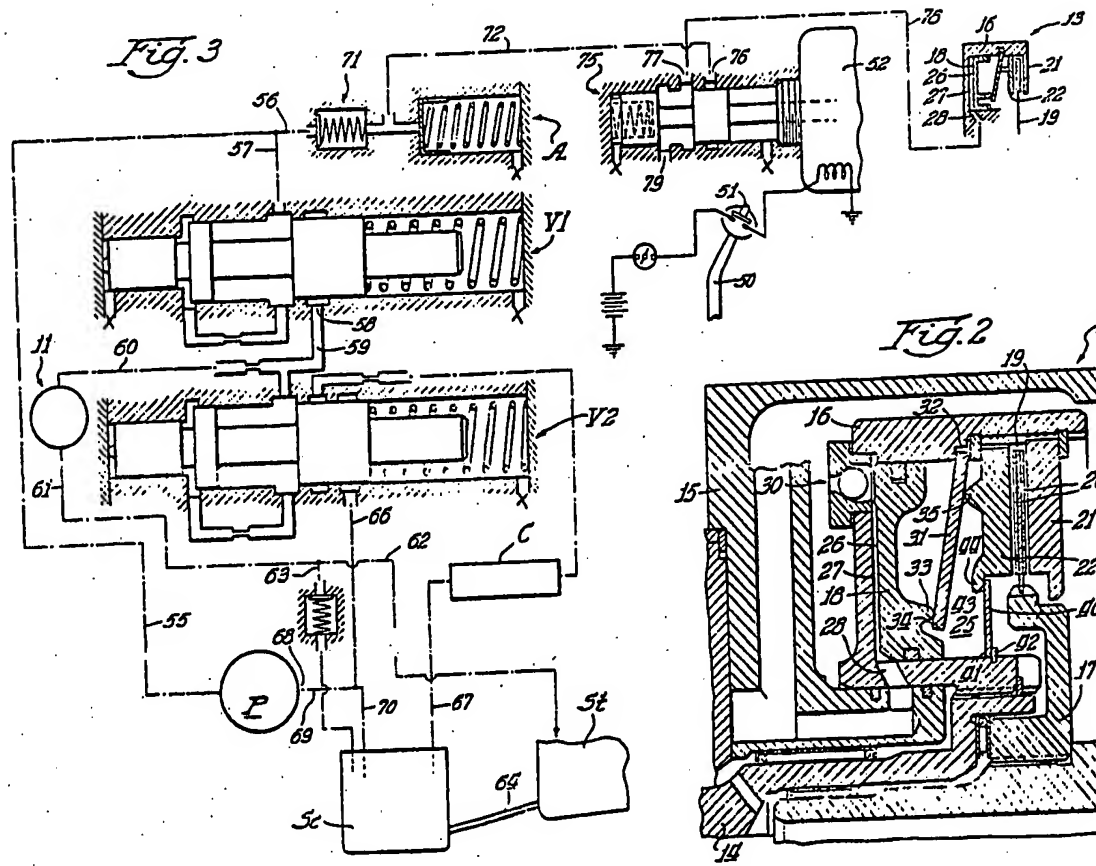

Fig. 2